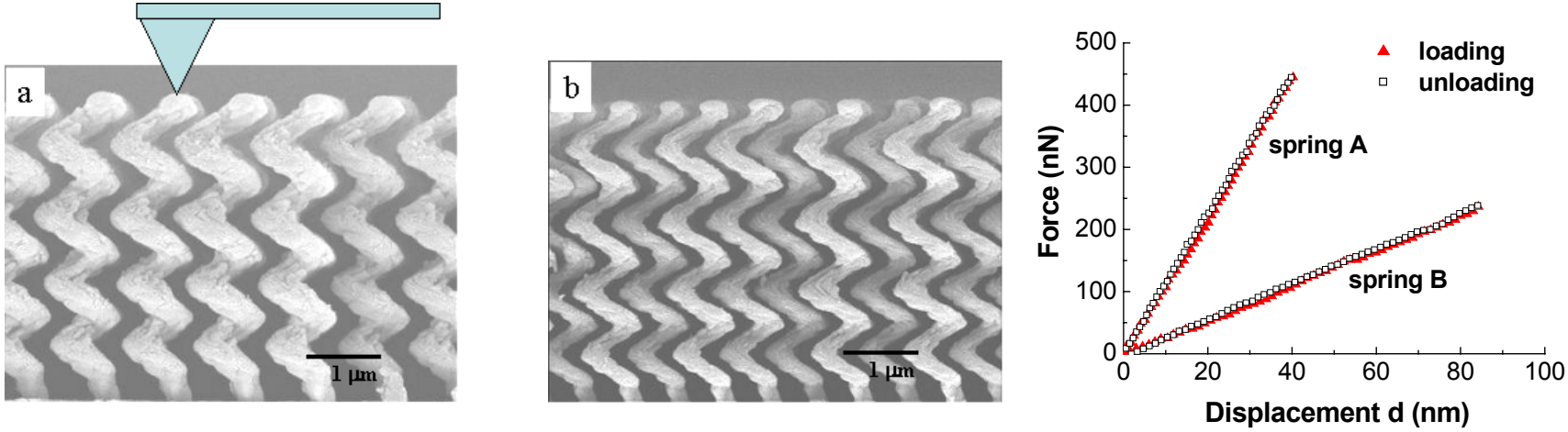
Mechanical Response of Isolated Helical Si Nanosprings

G.-C. Wang and T.-M. Lu, Rensselaer Polytechnic Institute, Award No. 0210587

The emerging field of nanotechnology requires basic understanding of the physical, electrical, and optical properties of nanoscale volumes of materials. In particular, knowledge of the mechanical behavior of materials in the nanoscale regime is essential for building useful nanomachines. We use an oblique angle incident deposition technique to grow three-dimensional *isolated* nanostructures with controlled size and geometry. We were able to measure the elastic response, including the spring constant, of individual Si helical-shape springs, using a tip-cantilever assembly attached to a conventional atomic force microscope. The Hooke's law is valid in the nanosprings that we measured.



Scanning electron microscopy cross section images of the separated four-turn Si helical nanosprings on patterned square lattice (right) and triangular lattice (middle). Left: Representative atomic force microscope loading (triangles) and unloading (open squares) force vs displacement curves for spring A and spring B. The slope gives the spring constant.

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Education and outreach:

A team of two graduate students and one undergraduate student contributed to this work. Dexian Ye grew the nanosprings and Deli Liu measured the mechanical response of nanosprings. The work of nanostructures made by oblique angle deposition received the best poster award in the New York Nanotech symposium. The undergraduate Fran Mateycik created an animation of spring response (Hooke's law). She is the outreach coordinator of the SPS (Society of Physics Student) Chapter. The chapter did outreach to local elementary and junior high schools regularly. The animation posted in the web site (http://www.rpi.edu/~mateyf/springs5.dcr) will be one of the highlights during the outreach show. The figures below are two illustrations for oblique angle deposition and spring response in the animation.